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GDP Fluctuations and Private Investment: A Macro Panel Analysis of Selected South Asian Countries

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Abstract

The current study examines the relationship between GDP fluctuations and private investment by using macro panel approach in a panel of five selected South Asian countries (SSAC) including Bangladesh, India, Nepal, Pakistan and Sri Lanka for the period of 1980-2010. The study applies modern non-stationary panel techniques such as cross section dependence test, unit root test under cross sectional dependence, panel co-integration and Group Mean Fully Modified OLS (GM-FMOLS) estimation.

The study finds a long-run co-integrating relationship between GDP fluctuations and private investment in the SSAC. GM-FMOLS estimates show that this link is negative. Thus, the results indicate that GDP fluctuations have a significant negative impact on private investment in SSAC as GDP volatility gives a negative signal to private investors. The study also suggests that GDP volatility may be harmful for private investment in developing countries and negative effect on private investment will also be transferred to growth as the investment is a key determinant of growth. So, the governments of developing countries should equally focus on managing the volatility of GDP to increase private investment along with other measures for creating an investment-friendly environment. Additionally, an increase in private investment will further help in maintenance of stability.

Keywords: GDP volatility, GDP fluctuations, private investment, uncertainty, south Asia, group mean FMOLS, panel co-integration, macro panel

1. Introduction

Fluctuations and volatility in GDP and other key macroeconomic variables is a serious constraint on development which makes planning more challenging and makes investment more uncertain and risky. A more stable macroeconomic environment may help in reducing the management problems and improve the prospects of realistic planning for sustainable growth and development (Ukwu et al*,* 2003). Therefore, the uncertainty measured in terms of volatility or instability poses a serious threat to

investment because investment needs more sustained and stable macroeconomic environment.

Developing countries generally suffer from a high degree of uncertainty as compared to the developed countries because the GDP growth, exchange rate and other key macro indicators are more volatile in developing countries, especially after financial liberalization. And the consequences of this volatility or uncertainty upon economic growth, investment and trade etc. are gaining attention in economic literature (Servén, 2002). The impact of uncertainty and volatility on investment has also received a lot of attraction of researchers and policy makers. Despite the majority of studies find a negative association between both of the variables; the literature is not conclusive in their assessment about the impact of uncertainty on investment (Servén, 1998). As Demir (2009) points out that there is no agreement in theory about the channels through which the relationship between uncertainty and investment holds. Similarly, Abel and Eberly (1994) argue that uncertainty increases investment whereas Aizenman and Marion (1999) argue the opposite.

In contrast to theoretical literature, the existing empirical work generally suggests that increasing risk and uncertainty have a significantly negative effect on private investment. However, the literature mostly uses the uncertainty measured in terms of volatility and instability of the exchange rate, inflation / prices, capital flows and terms of trade etc. The impact of uncertainty in terms of volatility in the growth rate of GDP or per capita GDP (*i.e.* GDP fluctuation) on private investment is not addressed much in empirical literature but the major objective of the present study is to analyze the impact of GDP fluctuations on private investment. Therefore, this study analyzes the relationship between private investment and uncertainty measured in terms of GDP volatility or fluctuations.

Moreover, as the investment has two major components *i.e.* private investment and public investment. Public investment is not much influenced through other macro variables or indicators, as it is like an autonomous investment which depends largely on government's discretion. In contrast, private investment depends on macroeconomic environment and is also affected by other macroeconomic variables like volatility of GDP. As, Ramey and Ramey (1995) find that the link between (aggregate) investment and volatility is less robust than the link between growth and volatility, however, Aizenman and Marion (1999) find more robust results by including only private investment instead of aggregate investment. Therefore, this study intends to explore and examine the impact of GDP fluctuations on private investment in South Asia/ SAARC region. However, the data for the variables included in current study is not available for whole SAARC region i.e. for Bhutan, Maldives and Afghanistan. Thus, a panel of five selected South Asian Countries (SSAC), including Bangladesh, India, Nepal, Pakistan and Sri Lanka has been chosen for the period of 1980-2010. The present study would be the premier South-Asia-focused work on GDP volatility and private investment. For empirical analysis, this study employs the modern non-stationary panel framework which account for cross sectional dependence including Breitung and Das (2005) panel unit root test, Pedroni co-integration tests and Group-Mean Fully Modified OLS (GM-FMOLS) estimation technique with common time dummies to account for cross-section dependence.

1.1 Hypothesis of the study

Along with direct negative impact on long-term growth rate, the GDP fluctuations also have a significant impact on GDP growth rate indirectly through channel of investment, which is amongst the key determinant of economic growth. Investment has two components i.e. public and private, public investment mainly relies on the discretion of government while the private investment is affected by the macroeconomic environment and an enabling environment is always needed to encourage private investors. A stable GDP growth rate send a positive signal to the private investors about an economy but a volatile growth rate discourages the private investment. Accordingly, to study the relationship between GDP fluctuations and private investment is also important for developing countries. Therefore, this study intends to test the following hypothesis:

- *There is a negative relationship between GDP fluctuations and private investment in SSAC*

Rationale: The GDP fluctuations have a negative impact on the private investment because the GDP growth rate is considered as an indicator of overall economic performance of the economy. So, a volatile GDP growth rate gives negative signal to the private investors and resultantly the private investment reduces.

1.2 Organization of the Paper

The organization of the rest of the paper follows as; the next section presents the brief review of literature. Section 3 presents the theoretical framework. Section 4 explains the data and model specification along with detailed econometric methodology. Section 5 discusses the estimation, results and findings. The last section 6 concludes the paper by presenting a summary of findings and policy recommendations.

2. Review of Literature

Almost all of the empirical literature found negative link between private investment and volatility. For example, Driver and Moreton (1991) studied the relationship between uncertainty (proxies by growth and inflation volatility) and investment in manufacturing machinery and plant in UK. The results of the study confirmed that the uncertainty in output growth is a negative determinant of capital formation. But, inflation uncertainty was found to have a short-run influence only.

Pindyck and Solimano (1993) examined the relationship between investment and volatility in a set of 29 (LDC and OECD) countries. They found that a moderate negative relationship for OECD is of greater magnitude for developing countries. The study also tried to relate the volatility of the marginal profitability of capital to index of economic instability such as inflation and its volatility and to indices of political instability.

Episcopos (1995) tried to find an empirical support on the relationship between uncertainty and irreversible investment by considering the uncertainty (volatility) in five major variables. Furthermore, the study used their conditional variance, estimated using ARCH methodology, to measure volatility (uncertainty) and their link with growth in fixed private investment was examined. The results of the study found a negative relationship between uncertainty and investment.

Servén (1998) re-examined empirically the link between investment and volatility (uncertainty), using a large data-set of developing countries. The study found a

significant negative link between the uncertainty and private investment in developing economies.

Aizenman and Marion (1999) found a significant negative link between volatility and private investment in a set of more than 40 developing countries even with the standard control variables**.** No correlation was found in the case of aggregate investment. While a positive correlation was found between public investment and volatility. The findings of the study suggested that the volatility has a detrimental impact on investment using disaggregated data.

Asteriou and Price (2000) examined the inter-linkages among uncertainty (volatility), investment and growth using panel-data of 59 industrial and developing countries for the period of 1966 to 1992. Applying mean group (MG) and Pooled Mean Group (PMG), study found that increased volatility reduces both investment and growth.

Temple, Urga and Driver (2001) examined the effect of uncertainty on investment in the UK. The study confirmed that both (macro and micro) sources of uncertainty have a significant negative effect on investment.

Moguillansky (2002) estimated a panel model of 16 countries of Latin America covering the period of 1970-2000. The study found that the financial volatility has significant negative impact on investment in Latin American countries. Servén (2002) studied the relationship between uncertainty (volatility) of real exchange rate and private investment on a large cross country time-series data set of developing countries. Measuring the real exchange rate volatility by GARCH-based model, study found that uncertainty has a significant negative effect on investment, even after controlling for other standard determinants of investment. In Addition, this negative impact of uncertainty on investment was noticeably larger in highly open economies having less developed financial systems.

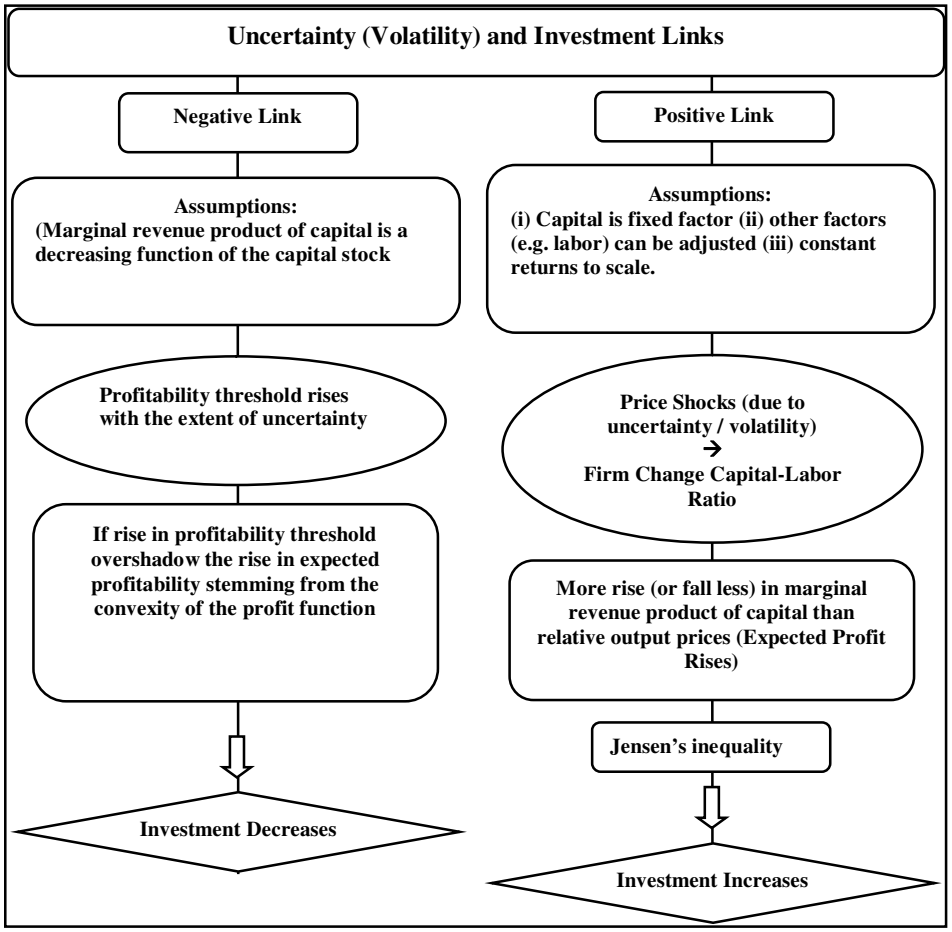
Aysan, et al (2005) also found the negative impact of macroeconomic volatility (measured by five-years moving standard deviation of GDP growth rate) on private investment decisions. This finding of the study also substantiated that a stable and sound investment climate is crucial for motivating private investors.

Harris *et al* (2006) using firm-level data, estimated a model of investment behavior under uncertainty in Thailand. Harris *et al* found strong evidence of a negative relationship between uncertainty and private investment. The study also discovered that the impact of uncertainty is related to measures of investment irreversibility, thus provides support to the view that firms' behavior conforms to the real options model of investment under uncertainty. Demir (2009) analyzed the impacts of macroeconomic uncertainty and country risk on private investment (under financial liberalization) in Argentina, Mexico and Turkey using Arellano and Bover's GMM method on micro-level panel data. The study found that increased macroeconomic uncertainty (in important macro-indicators like manufacturing price inflation and real exchange rate) has significant negative impact on new fixed investment of industrial firms.

Escaleras and Kottaridi (2010) studied the combined effect of macroeconomic uncertainty, socio-political instability and public provision on private investment using data of 37 developing countries for the period of 1970-2000. Using Arellano and Bond's GMM estimation, the study showed that macroeconomic uncertainty, macroeconomic

instability and socio-political instability all have a combined negative impact on private investment.

Bhandari and Upadhyaya (2010) studied the impact of real exchange rate uncertainty on the private investment using panel data of four countries of Southeast Asia (Indonesia, Malaysia, Philippines and Thailand) for 1972 to 2001. The study estimated the time series properties of the data and then an error correction model is developed and estimated using both the fixed effects and the random effects estimators. The estimated findings suggested that the real exchange rate uncertainty had a negative impact on the private investment in the region. Cherif and Hasanov (2012) construct a "store-or-sow" model of precautionary saving and investment to examine the impact of the volatility of permanent and temporary income shocks. The results of the study suggested that the higher volatility of permanent shocks results in an increase of investment and precautionary saving until a certain threshold after which investment drops while precautionary saving surges.



Error! No text of specified style in document.Figure 1: Volatility and Private Investment: Possible Link Channels

Source: Illustrated by the Authors based on literature

On the contrary, the higher volatility of temporary shock resulted in a fall of the investment while precautionary-saving gradually increases.

In a nutshell, we can conclude on the basis of review of empirical literature that the volatility or uncertainty has a negative impact on private investment.

3. Theoretical Framework

The theoretical literature identifies both positive and negative relationship between investment and volatility (Servén, 1998). A diagrammatic representation of links between volatility and investment is given in Fig. 1. On the one hand, a positive link between volatility and investment can be established, as Servén (1998) considers a case of a perfectly competitive firm under the assumptions that capital is fixed factor, other factors (e.g. labor etc.) can be adjusted and constant returns to scale prevails. Price shocks cause firms to alter capital-labor ratio resulting in more rise (or fall less) in marginal revenue product of capital than relative output prices.

In such case, marginal profitability is a convex function of output prices then Jensen's inequality implies that higher price volatility raises the expected profit of capital, thus increasing desired capital stock and investment (Hartman, 1972; Abel, 1983). Alternatively, a negative link between investment and volatility is established under the assumption that the marginal revenue product of capital is a decreasing function of the capital stock (Caballero, 1991). Servén (1998) points out that in such cases, the profitability threshold increase with the degree of uncertainty, and if this effect is enough powerful that to overshadow the rise in expected profitability stemming from the convexity of the profit function, resultantly the investment would be reduced.

4. Data and Methodology

4.1 Data Specifications

The annual data on the GDP per capita, private investment and other control variables including Foreign Direct Investment (FDI), Inflation rate (INF), Public Investment (PBI) and Current Account Deficit (CAD) for the period of 1981-2010 for SSAC is taken from the world development indicators (WDI) 2012 by World Bank (World Bank, 2012). The volatility or fluctuation in GDP is already measured using five-years moving standard deviation of per capita GDP growth rate from trend[1]. Detailed variable description is given in Table A.1 of Appendix.

[1] The five-year moving standard deviation from trend (SDFT) is calculated through taking the five-years moving standard deviation of cyclical component of the GDP per capita growth. The series of GDP per capita growth rate of each country, individually, has been decomposed into trend and cyclical components using the Hodrick-Prescott (HP) filter (Hodrick and Prescott, 1997) with a smoothing parameter set at 6.25 (as suggested by Ravn and Uhlig (2002) for annual data). Then the five years moving standard deviation of cyclical component has been calculated to get the SDFT. Hodrick and Prescott (1997) originally found that the value of smoothing parameter (λ) as 1600 for US quarterly data. Rand and Tarp (2002) find that business cycles in developing countries are significantly shorter in duration than cycles in developed countries.

The Foreign Direct Investment, Inflation rate, Public Investment and Current Account Deficit have been added as control variables as they are also considered as the key determinants of private investment. The Public Investment (PBI) is expected to have negative relation with private investment as public investment crowds out the private investment (Burney and Yasmeen, 1989; Pradhan, Ratha and Sarma, 1990; Ahmed, 1994; and Khan and Iqbal, 1991). Inflation is also expected to have negative relationship with Private Investment i.e. higher inflation lowers the private investment (Serven and Solimano, 1992). FDI is also expected to crowd out the private investment (Misun and Tomsik, 2002; and Agosin and Mayer, 2005).

4.2 Econometric Methodology

The main objective of the present study is to examine and explore the nature of the association private investment and GDP fluctuations. This is a well known fact that in a panel data having a relatively small sample of countries (N) with a longer time-series (T) i.e. macro-panel data, like present study, the existence of non-stationarity is more likely. Furthermore, the present study also likes to explore the reliability of past cross-sectional studies over time. Therefore, this study employs the panel co-integration framework. But, before continuing to the co-integration analysis checking the order of integration by applying the unit root tests is needed. Along with the unit root analysis another recently developed concept of the cross sectional dependence is also gaining lot of attraction in the current non-stationary panel literature. Therefore, the current study employs the Cross Sectional Dependence (CD) test by Pesaran (2004) before applying panel unit root test.

4.2.1 Cross Sectional Dependence Test

Pesaran (2004) suggests a simple test for testing cross-sectional dependence (CD) which can be applied to a variety of panel-data models including stationary and non-stationary dynamic heterogeneous panels. This CD test is based upon the average of pair-wise correlation coefficients of OLS residuals from the individual regressions in the panel rather than their squares like the Breusch–Pagan LM test (Baltagi, 2005).

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

4.2.2 Panel Unit Root Tests

The first step in studying a possible cointegrated relationship is to determine the order of integration of the variables and to test whether the variables involved are stationary or non-stationary. There are many tests available for testing unit root in panel data like Breitung (2000), Hadri (2000), Levin, Lin and Chu (2002) test (known as LLC test) and Im, Pesaran and Shin (2003) test (known as IPS test) etc. but these all test assumes cross sectional independence. As mentioned earlier that it is more likely that our data may have cross-sectional dependence, therefore, none of these above-mentioned tests can be used. Accordingly, the current study employs the Breitung and Das (2005) panel unit root test. The main advantage of the Breitung and Das (2005) is that it can also be applied in the

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Therefore, the present study uses the choice of λ=6.25 suggested by Ravn and Uhlig (2002) for annual data.

presence of cross-sectional dependence. In case of cross-sectional dependence the robust value are generated to account for the cross-sectional dependence otherwise in case cross-sectional independence the simple values are used.

4.2.3 Panel Co-integration tests

After confirmation about the order of integration of variables of interest, and if the variables are found non-stationary, the next step is to test for co-integration. Because, use of traditional OLS may give spurious results in the presence of a unit root. Although the first difference to prevent the spurious regression problem can also be taken but it also results in losing of long term information. Therefore, the current study uses the panel co-integration technique. For the panel co-integration test, the current study employs Pedroni (1997, 1999 and 2004a) panel co-integration tests. The main advantage of using Pedroni panel co-integration test is that it accounts for cross-section dependence if common time dummies added as Banerjee and Lluís (2006) pointed out that most panel data tests (including Pedroni) assume cross-section independence, except for common time effects. Therefore, the addition of common time effects (common time dummies) may account for the problem of cross-sectional dependence.

4.2.4 Pedroni Panel Co-integration Test

Pedroni Panel co-integration test is a significant improvement over the conventional co-integration tests applied on a single series. The panel regression model to analyze the long-run co-integrating relationship between private investment and GDP fluctuations, using Pedroni panel co-integration test, can be represented as under:

$$PVI_{i,t} = a_i + \delta_t + \sum_{m=1}^{M} \beta_{mi} FLUC_{mi,t} + e_{i,t} \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Where,

PVI = Private Investment

$FLUC$ = GDP fluctuations

Using the above equation, the null of no co-integration is tested through seven test statistics developed by Pedroni (1999). The first four statistics (Panel-*v*, Panel-ρ and Panel-*t* (PP and ADF)) are based on pooling the residuals along the within dimension of the panel. The rest of three statistics (Group-ρ and Group-t (PP and ADF)) are based on pooling the residuals along the between dimension of the panel. Under the alternative hypothesis, Panel-*v* statistic diverges to positive infinity. It is a one sided test therefore, where large positive values reject the null of no co-integration. The remaining statistics diverge to negative infinity, which means that large negative values reject the null of no co-integration.

4.2.5 Panel Estimation using GM-FMOLS Approach

These panel co-integration tests, just provides the information about the existence of the long-run equilibrium relationship among the variables, it doesn't estimate the cointegrating vectors For this purpose, the present study uses Group Mean (Panel) Fully Modified Ordinary Least Squares (GM-FMOLS) developed by Pedroni (2001a, 2001b, 2004b) which is an extension of time-series Fully Modified OLS (FMOLS) by Phillips and Hansen (1990). The main advantage of using GM-FMOLS estimator is that it not only gives consistent estimates of the β parameters in relatively small samples, but it also

controls for the likely endogeneity of the regressors and serial correlation (Ramirez, 2010; AlYousef, 2013). This technique also controls the likely cross-sectional dependence by including common time dummies in the model (Pedroni, 2001a; Lee, 2007). Another method which allows estimation in the presence of cross-sectional dependence is the Pesaran (2006) CCEMG estimator. But Pesaran (2006) is the extension of Pesaran and Smith (1995) MG and Pesaran, shin and Smith (1999) PMG estimator. Tsangarides, Saxegaard, and Roudet (2007) pointed out that GM-FMOLS estimators have satisfactory size and power properties even for small panels, as long as T is larger than N and in the presence of homogeneous cointegrating vector mean-group estimators have better small sample performance than within group estimators. Tsangarides et al (2007) further highlighted the PMG estimator imposes long-run homogeneity, it can also produce inconsistent estimates of the average values of the parameters if the assumption of homogeneity is violated in practice. Therefore, the present study employs GM-FMOLS with common time dummies to estimate the long-run cointegrating vector. To model the relationship between GDP fluctuations and private investment a simple model is constructed as,

$$PVI_{i,t} = \alpha_i + \beta_i FLUC_{i.t} + \gamma_i X_{i,t} + \varepsilon_{i,t} \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

Here, PVTINV is private investment, FLUC is the GDP Fluctuations, α is intercept, β_i is elasticity coefficient (to be measured to examine the relationship between private investment and fluctuations) and expected to be negative for developing countries as in the case of SSAC, ε is residual of equation or random error-term. While *i* represents the country and *t* represents the time-period (a year, in case of this study). The X represents a set of control variables including Foreign Direct Investment (FDI), Inflation rate (INF), Public Investment (PBI) and Current Account Deficit (CAD).

All the idiosyncratic (individual country) coefficients ($\hat{\beta}^{*}_{FM,i}$) and associated *t – statistic* for each country (*i*) are estimated using above equation (6.3) and the Group Mean (Between-Dimension) Panel estimates ($\hat{\beta}^{*}_{GFM}$) can be calculated using the following formula by Pedroni (2004b).

$$\hat{\beta}_{GFM} = N^{-1}\sum_{t-1}^{N}\left(\sum_{t-1}^{T}(P_{it}-\overline{P}_i)\right)^{-1} \times \left(\sum_{t-1}^{T}(P_{it}-\overline{P}_i)s^{*}_{it} - T\,\hat{\gamma}_i\right) \quad \ldots \quad \ldots \quad (4)$$

Where,

$$s^{*}_{it} = \left(S_{it}-\overline{S}_i\right) - \frac{\hat{\Omega}_{21i}}{\hat{\Omega}_{22i}}\Delta p_{it}$$

$$\hat{\gamma}_i = \hat{\Gamma}_{2\mathrm{li}} + \hat{\Omega}^{\mathrm{o}}_{2\mathrm{li}} - \frac{\hat{\Omega}_{21\mathrm{i}}}{\hat{\Omega}_{22\mathrm{i}}}(\hat{\Gamma}_{22\mathrm{i}} + \hat{\Omega}^{\mathrm{o}}_{2\mathrm{li}})$$

In the above equation 4, the expression after $N^{-1}\sum_{t-1}^{N}$ is similar to the conventional idiosyncratic time-series estimator ($\hat{\beta}^{*}_{FM,i}$), therefore, the between dimension panel estimator ($\hat{\beta}^{*}_{GFM}$) can be constructed simply by,

$$\hat{\beta}^{*}_{GFM} = N^{-1}\sum_{t-1}^{N}\hat{\beta}^{*}_{FM,i} \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

Where, $\hat{\beta}^{*}_{FM,i}$ is the conventional time-series (individual country) FMOLS estimator of *ith* member of panel. Similarly, related t-statistic for the between dimension panel estimator can be measured by the following formula of Pedroni (2004b).

$$t_{\hat{\beta}^{*}_{GFM}} = N^{-1/2}\sum_{t-1}^{N} t_{\hat{\beta}^{*}_{FM,i}} \quad \ldots \quad \ldots \quad (6)$$

Where, $t_{\hat{\beta}^{*}_{FM,i}}$ is the conventional time-series (individual country, *i*) t-statistic, of *ith* member of panel, associated with related $\hat{\beta}^{*}_{FM,i}$. The formula of $t_{\hat{\beta}^{*}_{FM,i}}$ is given as,

$$t_{\hat{\beta}^{*}_{FM,i}} = \left(\hat{\beta}^{*}_{FM,i} - \beta_o\right)\left(\hat{\Omega}^{-1}_{11i}\sum_{t-1}^{T}(P_{it} - \bar{P}_i)^2\right)^{1/2} \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

5. Empirical Results

5.1 Cross Sectional Dependence Test

The results of CD Test by Pesaran (2004) are given in the Table 1 which shows that except GDP fluctuations (FLUC), and Public Investment (PBI) the null of no cross-sectional independence can be rejected i.e. all these variables (except the FLUC and PBI) are found as cross-sectionally dependent variables.

Table 1: Cross Sectional Dependence (Private Investment & GDP Fluctuations)

Variable	CD-test	p-value	corr	abs(corr)
PVI	2.48	0.013	0.151	0.365
PBI	0.74	0.462	0.045	0.249
INF	4.38	0.000	0.267	0.274
CAD	5.87	0.000	0.357	0.357
FDI	6.59	0.000	0.401	0.462
FLUC	0.54	0.588	0.033	0.242

Notes: Under the null hypothesis of cross-section independence CD ~ N(0,1) Source: Author's Calculation

5.2 Panel Unit Root Test

The results of Breitung and Das (2005) panel unit root test at level are shown in Table 2.

Table2: Breitung and Das (2005) Panel Unit Root Test (at Level)

Lambda Statistic (Probability in parenthesis)					
CAD	**FLUC**	**FDI**	**INF**	**PBI**	**PVI**
With Intercept Only					
-1.7815** (0.0374)	-0.4644 (0.3212)	0.4500 (0.6737)	-4.1055*** (0.000)	-2.4888*** (0.0064)	-0.8681 (0.1927)
With Intercept and Trend					
0.7732 (0.7803)	-1.4907 (0.0680)	1.5312 (0.9371)	-0.3696 (0.3558)	0.7093 (0.7609)	-0.3608 (0.3591)

*** & ** represent the rejection of null hypothesis of no unit root at 1% & 5% level of significance respectively

The value of lambda (λ) statistic shows that at level all the variables are non-stationary at 5% level of significance. The robust values of lambda (λ) are given to account for cross-sectional dependence except the FLUC and PBI which are the cross-sectionally independent variables.

The results of Breitung and Das (2005) panel unit root test at first difference are given in Table 3.

Table 3: Breitung and Das (2005) Panel Unit Root Test (at 1st Difference)

Lambda Statistic (Probability in parenthesis)					
CAD	**FLUC**	**FDI**	**INF**	**PBI**	**PVI**
With Intercept Only					
-4.5895*** (0.0000)	-7.4447*** (0.000)	-4.2492*** (0.0000)	-7.3931*** (0.0000)	-3.952*** (0.000)	-6.8208*** (0.0000)
With Intercept and Trend					
-4.3143*** (0.0000)	-6.7141*** (0.000)	-1.9967** (0.0229)	-4.1125*** (0.0000)	-2.818*** (0.0024)	-5.7488*** (0.0000)

*** & ** represent the rejection of null hypothesis of no unit root at 1% & 5% level of significance respectively

The table shows that all the variables become stationary at first difference at 5% level of significance. The results of Breitung and Das (2005) panel unit root test shows that all the variables are integrated of order one i.e. I(1).

5.3 Panel Co-integration Test

After the establishment of the order of integration of the variables, the results of the Pedroni panel co-integration tests are shown in Table 4.

Table 4: Pedroni Panel Co-integration Test Results for PVI & FLUC

Test Statistics	**With Intercept and No Trend+**		**With Intercept and Trend+**	
	Un-weighted	**Weighted++**	**Un-weighted**	**Weighted++**
panel v-stat	-0.8701	-1.0459	-0.0665	0.0568
panel rho-stat	0.7657	0.7813	0.5201	0.2688
panel pp-stat	-1.5237*	-1.3797*	-3.0623***	-3.6928***
panel adf-stat	-0.0420	-0.2815	-1.2749*	-2.3056***
group rho-stat	1.4328	1.4328	1.1532	1.4328
group pp-stat	-1.5264*	-1.5264*	-3.7361***	-1.5264*
group adf-stat	-1.0850	-1.0850	-1.5722**	-1.0850

Null hypothesis: no co-integration, + common time dummy included to account for cross sectional dependence, ++ Panel stats are weighted by long run variances, *. ** & **

represent the rejection of null hypothesis of no unit root at 10%, 5% & 1% level of significance respectively

The Pedroni's two out of seven panel test statistics shows the existence of long-run equilibrium relationship between private investment, GDP fluctuations and other control variables in SSAC in case of model with intercept and no trend. While, four out of seven test statistic show the existence of long-run relationship between private investment and GDP fluctuations in SSAC in case of model with intercept and trend. Consequently, the existence of a long-run cointegrating relationship between private investment and GDP volatility is confirmed by Pedroni panel co-integration test.

5.4 GM-FMOLS Results and Discussions

The long-run Pedroni Group-Mean (Between-Dimension) FMOLS estimates are presented in Table 5[2]. The results of the GM-FMOLS estimates show a negative and significant relationship between private investment and GDP fluctuations in SSAC.

The results of current study are similar to those of the literature as almost all of the empirical studies found a negative link between private and GDP volatility. Furthermore, the other control variables also have significant relation with private investment.

Table 5: Group Mean Fully Modified OLS (GM-FMOLS) Results

Dependent Variable: Long-run Growth (PVI)			
Variable	**Coefficient**	**t – Statistics**	
GF	-0.9020	-3.3174***	
PBI	-1.0317	-11.5541***	
INF	-0.1597	-1.8592***	
FDI	-1.8475	-4.4728*	
CAD	0.5884	3.7730***	
Constant	0.1018	0.6313	
Diagnostic Testing			
Residual Stationarity	I(0)	**CD Test for Residual**	-0.60 (0.546)
F Test	3.6624 (0.013)	**RMSE**	0.7322

* and *** represents 10% and 1% significance level respectively

The coefficient for Public Investment (PBI) is negative and significant which shows that public investment crowds out the private investment in SSAC. Burney and Yasmeen (1989), Pradhan, Ratha and Sarma (1990), Ahmed (1994) and Khan and Iqbal (1991) also finds the similar results i.e. support crowding out hypothesis. Inflation has negative and significant relationship with Private Investment i.e. higher inflation lowers the private investment. Serven and Solimano (1992) also find that the rate of inflation has an adverse impact on investment. FDI also crowds out the private investment as its coefficient is negative and significant. Misun and Tomsik (2002) and Agosin and Mayer (2005) found similar results i.e. FDI crowds out private investment. The current account deficit has positive and significant relation with private investment.

[2] The GM-FMOLS model is estimated using RATS code (PANELFM) by Doan (2012).

6. Conclusion and Policy Implications

This study investigates the impact of GDP fluctuations on private investment by using macro-panel techniques in a panel of five selected South Asian countries (SSAC) over a period of 1980-2010. For this purpose, modern non-stationary panel techniques such as cross section dependence test, panel unit root testing under cross section dependence, panel co-integration and Group Mean Fully Modified OLS estimation are applied. This study is a premier South Asia specific study on the topic of GDP Fluctuations and private investment which uses modern macro-panel approach for empirical analysis. However, there is further space for more research on the topic, especially; there is a need of country-specific time-series as well as region specific macro-panel studies.

The study finds that there exists a long-run cointegrating relationship between GDP fluctuations and private investment in the SSAC. FMOLS estimates show that this link is negative. These results are similar with literature that almost all the studies (e.g. Servén, 1998; Aizenman and Marion, 1999; Asteriou and Price, 2000; Escaleras and Kottaridi, 2010 and many others) found similar negative association between private investment and GDP fluctuations. Thus, the results indicate that GDP fluctuations might have a significant negative impact on private investment in SSAC as GDP volatility gives a negative signal to private investors. Furthermore, the other determinants of private investment (added as control variables in model) were also found significant and as per theory and empirical literature.

Furthermore, the other control variables also have significant relation with private investment and these results are as per the literature. For example, the coefficient for Public Investment (PBI) is negative and significant which shows that public investment crowds out the private investment in SSAC i.e on the one hand resources used by the public sector for public investment leave less loan-able funds for private sector and, on the other hand, increase in government borrowing may result in increase in interest rate which ultimately reduces the private investment. Burney and Yasmeen (1989), Pradhan, Ratha and Sarma (1990), Ahmed (1994) and Khan and Iqbal (1991) also find the similar results i.e. support the crowding out hypothesis. Similarly it has also been found that FDI too crowds out the private investment as its coefficient is negative and significant which shows that inflow of FDI hampers the entry of domestic private investors. Misun and Tomsik (2002) and Agosin and Mayer (2005) found similar results that FDI crowds out private investment. The study finds that Inflation has negative and significant relationship with Private Investment i.e. higher inflation lowers the private investment. Serven and Solimano (1992) also find that the rate of inflation has an adverse impact on investment.

These findings have serious policy implications for developing countries generally and for South Asia particularly. The significant negative impact of GDP fluctuations on private investment suggests that GDP volatility may be harmful for private investment in developing countries and negative effect on private investment will also be transferred to growth as the investment is a key determinant of growth. So, the governments should equally focus on managing the volatility of GDP to increase private investment along with taking other measures for creating an investment-friendly environment. In Addition, the increase in private investment will further help in maintaining stability.

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Appendix

Table A.1: Definitions and Sources of Variables

Variable Acronym	Variable Description	Source
FLUC	GDP Fluctuations, GDP fluctuations are measured by the five-years moving standard deviation (SD) of Per Capita GDP growth from trend (five-years moving SD of cyclical component, decomposed by HP filter).	Author Calculation based on WDI data on GDP per capita growth
PVI	Private Investment proxied by Gross fixed capital formation, private sector (% of GDP)	WDI 2012, Online
CAD	Current Account Deficit as % of GDP	WDI 2012, Online
FDI	Foreign Direct Investment as % of GDP	WDI 2012, Online
INF	CPI Inflation rate	WDI 2012, Online
PBI	Public Investment proxied by Gross fixed capital formation, public sector (% of GDP	WDI 2012, Online